MITSUBISHI
Mitsubishi Industrial Robot

CRn-500 series INSTRUCTION MANUAL

Conveyor tracking function

DRAFT

MELFA

BFP-A8337Z-a

⚠ Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠CAUTION

All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
→ Enforcement of safety training

⚠CAUTION

For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
→ Preparation of work plan

⚠WARNING

Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
→ Setting of emergency stop switch

⚠CAUTION

During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
→ Indication of teaching work in progress

⚠WARNING

Provide a fence or enclosure during operation to prevent contact of the operator and robot.
→ Installation of safety fence

⚠CAUTION

Establish a set signaling method to the related operators for starting work, and follow this method.
→ Signaling of operation start

⚠CAUTION

As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
→ Indication of maintenance work in progress

⚠CAUTION

Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
→ Inspection before starting work

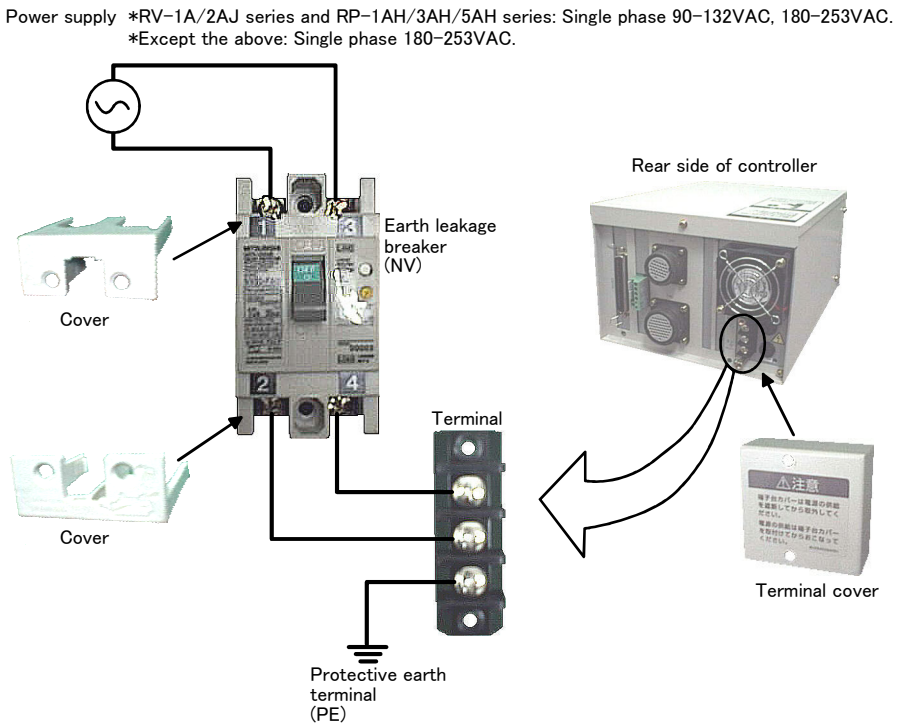
The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

⚠CAUTION	Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)
⚠CAUTION	Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.
⚠CAUTION	Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.
⚠CAUTION	Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.
⚠CAUTION	Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.
⚠CAUTION	Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.
⚠WARNING	Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.
⚠WARNING	Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.
⚠CAUTION	Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.
⚠WARNING	When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.
⚠CAUTION	Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.
⚠CAUTION	After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.
⚠CAUTION	Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.
⚠CAUTION	Never carry out modifications based on personal judgments, or use non-designated maintenance parts. Failure to observe this could lead to faults or failures.
⚠WARNING	When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.
⚠CAUTION	Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF. If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.
⚠CAUTION	Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information of the robot controller may be damaged.

C.Precautions for the basic configuration are shown below.(When CR1-571 is used for the controller.)

⚠CAUTION

Provide an earth leakage breaker that packed together on the primary power supply of the controller as protection against electric leakage. Confirm the setting connector of the input power supply voltage of the controller, if the type which more than one power supply voltage can be used. Then connect the power supply.
Failure to do so could lead to electric shock accidents.



⚠WARNING

For using RH-5AH/10AH/15AH.
While pressing the brake releasing switch on the robot arm, beware of the arm which may drop with its own weight.
Dropping of the hand could lead to a collision with the peripheral equipment or catch the hands or fingers.

Revision history

Date of Point	Instruction Manual No.	Revision Details
2004-01-16	BFP-A8337Z-a	First print.

■ Introduction

Thank you for purchasing the Mitsubishi industrial robot.
This instruction manual describes the specification and startup and adjustment procedures of the conveyor tracking function, as well as details of relevant MELFA-BASIC IV commands.
Always read through this manual before starting use to ensure correct usage of the robot.
The information contained in this document has been written to be accurate as much as possible. Please interpret that items not described in this document "cannot be performed.".

The contents given in this manual correspond to the controller of the following type.

<Controller Type>
- CR1-571
- CR2A-572
- CR2B-574
- CR3-535M

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1 Before starting use

This chapter explains the details and usage methods of the instruction manuals, the basic terminology and the safety precautions.

1.1 Using the instruction manuals

1.1.1 The details of each instruction manuals

The contents and purposes of the documents enclosed with this product are shown below. Use these documents according to the application.
For special specifications, a separate instruction manual describing the special section may be enclosed.

Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller Setup, Basic Operation and Maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Detailed Explanation of Functions and Operations	Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc.
Explanations of MOVEMASTER COMMANDS	Explains details on the MOVEMASTER commands used in the program. (For RV-1A/2AJ and RV-2A/3AJ series)
Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.

1.1.2 Symbols used in instruction manual

The symbols and expressions shown in Table 1-1 are used throughout this instruction manual. Learn the meaning of these symbols before reading this instruction manual.

Table 1-1 : Symbols in instruction manual

Symbol	Meaning
⚠DANGER	Precaution indicating cases where there is a risk of operator fatality or serious injury if handling is mistaken. Always observe these precautions to safely use the robot.
⚠WARNING	Precaution indicating cases where the operator could be subject to fatalities or serious injuries if handling is mistaken. Always observe these precautions to safely use the robot.
⚠CAUTION	Precaution indicating cases where operator could be subject to injury or physical damage could occur if handling is mistaken. Always observe these precautions to safely use the robot.
[JOINT]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
[+／ＦＯＲＷＤ] ＋ [＋Ｘ] （Ａ）　（Ｂ）	This indicates to press the (B) key while holding down the (A) key. In this example, the [+/Forward] key is pressed while holding down the [+X/+Y] key.
[ＳＴＥＰ／ＭＯＶＥ] ＋([ＣＯＮＤ]→[ＲＰＬ ↓]) （Ａ）　（Ｂ）　（Ｃ）	This indicates to hold down the (A) key, press and release the (B) key, and then press the (C) key. In this example, the [Step/Move] key is held down, the [Condition] key is pressed and released, and the [Replace ↓ key is pressed.
Ｔ／Ｂ	This indicates the teaching pendant.

1.2 Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠ CAUTION All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
→ Enforcement of safety training

⚠ CAUTION For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
→ Preparation of work plan

⚠ WARNING Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
→ Setting of emergency stop switch

⚠ CAUTION During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
→ Indication of teaching work in progress

⚠ DANGER Provide a fence or enclosure during operation to prevent contact of the operator and robot.
→ Installation of safety fence

⚠ CAUTION Establish a set signaling method to the related operators for starting work, and follow this method.
→ Signaling of operation start

⚠ CAUTION As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
→ Indication of maintenance work in progress

⚠ CAUTION Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
→ Inspection before starting work

1.2.1 Precautions given in the separate Safety Manual
The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

⚠ CAUTION Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)

⚠ CAUTION Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.

⚠ CAUTION Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.

⚠ CAUTION Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.

⚠ CAUTION Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.

⚠ CAUTION Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.

⚠ WARNING Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.

⚠ WARNING Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.

⚠ CAUTION Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.

⚠ WARNING When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.

⚠ CAUTION Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.

⚠ CAUTION After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.

⚠ CAUTION Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.

⚠ CAUTION Never carry out modifications based on personal judgments, or use non-designated maintenance parts.
Failure to observe this could lead to faults or failures.

⚠ WARNING When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

⚠ CAUTION Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF.
If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.

⚠ CAUTION Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters.
If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information of the robot controller may be damaged.

2 Tracking function and specification

2.1 What is tracking?

The conveyor tracking function controls the robot to work synchronously with the movement of the conveyor without stopping the conveyor.
This function features the following:

(1) Because a vision sensor can be incorporated in the system, the robot can operate by tracking unaligned workpieces on the conveyor, multiple types of workpieces, and multiple workpieces.
(2) The robot can detect the arrival of a workpiece by a photoelectric sensor, and can operate by tracking it.
(3) By entering the data of the encoder installed on the conveyor into the controller, the travel speed of the conveyor can automatically be calculated, allowing the support for conveyors with variable travel speed.
(4) The operation can be written with the robot language (MELFA-BASIC Ⅳ).

2.2 Tracking system configuration

Examples of the conveyor tracking system configuration are shown below.

(1) Example of usage by incorporating a vision sensor and a photoelectric sensor

In this configuration example, when a workpiece on the conveyor passes the photoelectric sensor, the vision sensor measures the workpiece position, and the robot tracks the workpiece traveling on the conveyor. Because the workpiece positions are measured by the vision sensor, it is not necessary to align workpieces.
It is suited for situations where workpieces are unaligned and they are being conveyed one by one.

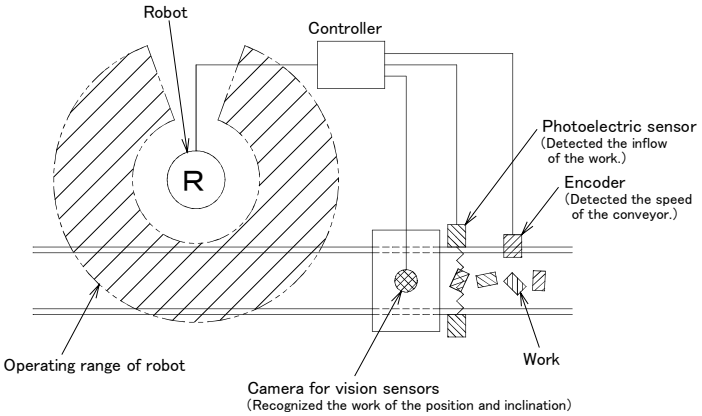


Fig.2-1 : Example of usage by incorporating a vision sensor and a photoelectric sensor

(2) Example of usage by incorporating a photoelectric sensor only

In this configuration example, when a workpiece on the conveyor passes the photoelectric sensor, the robot tracks that workpiece.
It is suited for situations where work pieces are aligned and they are being conveyed one by one.

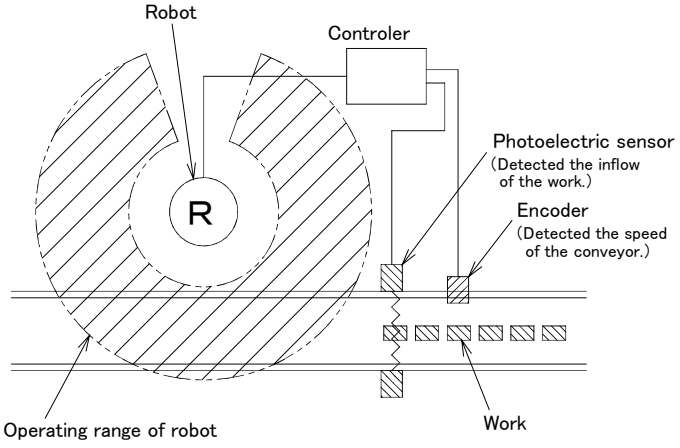


Fig.2-2 : Example of usage by incorporating a photoelectric sensor

(3) Example of usage by incorporating a vision sensor only

In this configuration example, the vision sensor periodically measures the workpiece positions and the robot tracks the workpieces traveling on the conveyor. Because the workpiece positions are measured by the vision sensor, it is not necessary to align workpieces.

It is suited for the situation where a large quantity of unaligned workpieces travel on the conveyer continuously.

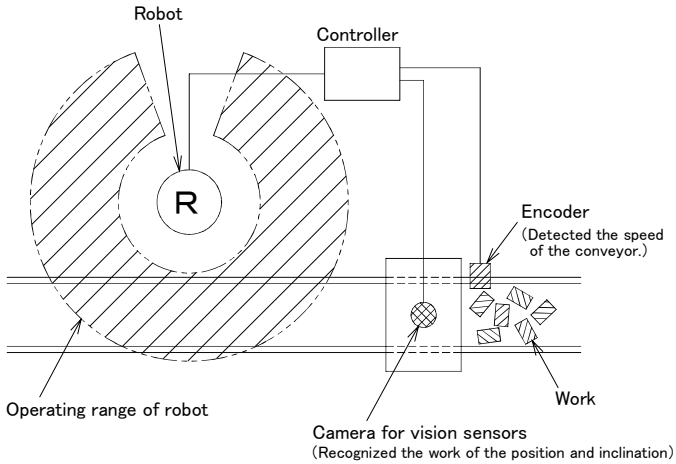


Fig.2-3 : Example of usage by incorporating a vision sensor

2.3 Tracking specification

(1) Tracking system specification

The tracking specification is shown in Table 2-1.

Refer to separate manual "Standard Specifications Manual" for the specification of robot arm and controller.

Table 2-1 : Tracking specification

Item		Specifications	Remarks
Supported robot		RP-1AH/3AH/5AH series RV-1A/2AJ RV-2A/3AJ sereis RV-4A/5AJ/3AL/4AJL series RH-5AH series RH-10AH/15AH series RV-6S/6SL/12S/12SL series	Attached to the tracking interface. (Serial interface x 2) (Encoder interface x 2)
Conveyor	Move speed Note1)	Applicable up to 20m/min approx..	Can be supported by two conveyor at the same time.
	Encoder	Power voltage is 5V. ABZ phase line driver output.	Recommendation parts Maker : Omron Type : E6B2-CWZ1X (line driver out put)
Vision sensor Note2)		A built-in vision sensor, or an external vision sensor that can output measurement results in ASCII code via RS-232C	External vision sensors include the AS50VS made by Mitsubishi.
Photoelectric sensor			For the tracking synchronization Note3)

Note1) The specification values in the table are presented as guidance, and the actual values depend on the details of operation, robot model, hand, etc.

Note2) It is recommended to connect an external vision sensor with the robot controller via the RS-232C connector of the tracking interface card that comes with the product. For more information about the specification of the tracking interface connector, refer to "Appendix 3 :Connector pin assignments of tracking interface" on page 32.

Note3) Connect the photoelectric sensor input to the input connector for the general-purpose input signals of the robot controller or the synchronous signal of the built-in vision sensor.

3 Confirmation before use

3.1 Tracking specification robot.

Please verify the configuration relevant to the tracking specification robot you have purchased shown in Table 3-1. The model and configuration of the controller varies with the model of the robot arm to be used. Table 3-2 lists the combinations of the robot arm and the controller.
Also, the accessories of the standard specification robot are supplied with this product. For more information about these components, refer to separate document entitled "Instruction Manual/Robot Arm Setup to Maintenance" and "Instruction Manual/Controller setup, basic operation, and maintenance."

Table 3-1 : Configuration equipment

Part name	Type	Qty.	Remarks
Robot arm, controller	Refer to Table 3-2	1 set	Refer to the Table 3-2 about the type.
Tracking interface		1 pc.	Serial interface × 2, encoder interface × 2
Instruction manual	BFP-A8337	1 copy	CRn-500 series INSTRUCTION MANUAL/Conveyor tracking function.
Sample floppy disk	—	1 pc.	Sample program
Ferrite core	—	1 pc.	For encoder cables.

Table 3-2 : Combination of the robot arm and the controller. (Reference)

Robot arm type	Controller type	Remarks
RP-1AH/3AH/5AH series	CR1-571	
RV-1A/2AJ	CR1-571	
RV-2A/3AJ series	CR1-571	
RV-4A/5AJ/3AL/4AJL series	CR2A-572	
RH-5AH series	CR1-571	
RH-10AH/15AH series	CR2A-572	
RV-6S/6SL series	CR2B-574/CR3-535M	
RV-6S/6SL series	CR3-535M	

3.2 Other required equipment

The following shows the devices required in addition to the configuration of the tracking specification robot you have purchased.

(1) Devices required for conveyor calibration

In order to perform conveyor calibration using a sample program (floppy disk) that comes with the product, Personal Computer Support software is required. Personal Computer Support software and a connection cable are optional items, however a personal computer must be provided by the customer.
Also, a calibration jig is required to teach the robot the positions on the conveyor. This jig can be made by the customer, or can be loaned from us if requested. If the customer wishes to loan the jig from us, please contact our dealer.

Table 3-3 : Personal computer support software

Part name	Type	Qty.	Remarks
Personal computer	—	1 set	Prepared by customer. (attached to the 3.5 inch floppy disk drive)
Personal computer support software	3A-01C-WINE or 3A-02C-WINE	Either 1 pc.	Mitsubishi's option 3A-01C-WINJ : Personal computer support software 3A-02C-WINJ : Personal computer support software mini
Connection cable	RS-MAXY-CBL or RS-AT-RCBL	Either 1 pc.	Mitsubishi's option RS-MAXY-CBL : For RS-232C connectors of the front of the controller RS-AT-RCBL : Serial interface appended by expansion option box (CR1-571).
For calibration jig	—	1 pc.	Install to the mechanical interface of the robot arm and use for operations at the calibration.

(2) The equipment required by application

Table 3-4 lists the devices required, including optional items of the robot, depending on the application of the tracking system to be used by the customer, as a reference.

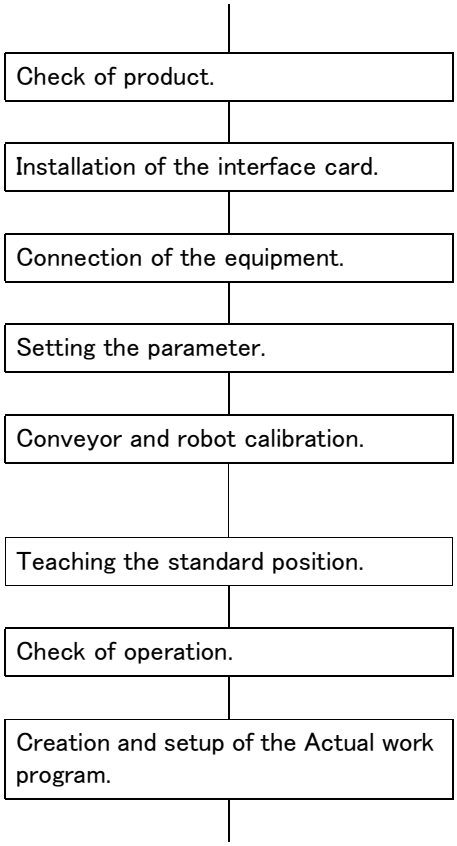
Table 3-4 : The equipment required by application.(Reference)

Item	Part name	Type Note1)	Specifications	Qty.	Remarks
Robot section					
1	Teaching pendant (T/B)	R28TB *		1	
2	Pneumatic hand interface	2E-32HND *		1	Required when using the wiring and piping for the hand in the robot arm for control of the pneumatic hand.
3	Solenoid valve set	1E-VD01 * Note2)		1	
4	Hand input cable	1A-HC20 * Note3)		1	
5	Hand			1	
6	Sensor for hand			1	For the confirming the work holding.
Conveyor section					
1	Conveyor (attached to encoder) Note4)		Encoder: E6B2-CWZ1X Recommendation connector for the input terminal of encoder: 3COM Plug 10120-3000VE Shell 10320-52F0-008	1	Recommendation parts: Omron.
2	Photoelectric sensor			1	For the tracking synchronization.
Vision sensor section Note5)					When using the vision sensor.
1	Vision sensor basic set	4A-RZ511 *		1	One piece is attached each to 4A-RZ511.
	Built-in vision sensor interface	RZ-511		(1)	
	Camera cable (5m)	2A-VC00CBL-05		(1)	
	Monitor cable (5m)	2A-VM00CBL-05		(1)	
	Trackball change cable (4m)	2A-VB00CBL-04		(1)	
2	Lens		Cmount lens	1	
3	Trackball	TB-3PS		1	SANWA SUPPLY INC.
4	Monitor	9VM20A		1	TOKYO ELECTRONIC INDUSTRY CO., LTD.
5	Lighting equipment			1	

Note1) Indicates that it is the robot's option when the * mark attached to the type.
Note2) The type changes with the robot arm. (1E-VD01 is an example for RV-2A)
Note3) The type changes with the robot arm. (1A-HC20 is an example for RV-2A))
Note4) Connect the signal of the encoder to the encoder input of the tracking interface by the recommendation connector (customer preparation). Prepare the encoder power supply by the customer.
Note5) The example of composition when using the built-in vision sensor is shown in the Table 3-4.

4 The flow of work

The system is set up in the following procedure.



Refer to "3Confirmation before use" on page 7, and confirm the configuration of the bought product.

Installing the tracking interface card and built-in vision sensor (when using it) to controller.

Connecting the vision sensor, switch and encoder of conveyor.

Setting the parameter is required for tracking control

Set the relationship between the robot coordinate system and the operating direction of the conveyor, and the detection coefficient of the conveyor travel speed. If a vision sensor is used, also set the relationship with the vision sensor coordinate system.

Teaching the work position(standard position) to the work on conveyor.

Create a simple program and have the robot perform a tracking operation for workpieces on the conveyor. Verify that the various settings are correctly specified.

Actual work is done.

Fig.4-1 : The flow of work

5 Installing the interface card

The following shows how to install the tracking interface card for each type of controller used. If the controller is the CR1-571, see Section "5.1.1For CR1-571 controller". If the controller is the CR2A-572, see Section "5.1.2For CR2A-572 controller".

Also install option cards such as a built-in vision sensor card here, and connect required devices. For more information about the installation of other option cards and the connection method of required devices, refer to the instruction manual that comes with each option card.

Furthermore, please refer to the installation method of the option cards described in "Installing the option devices" in the separate document entitled "Instruction Manual/Controller Setup and Basic Operation to Maintenance."

[Reference] If a built-in vision sensor card is used, installing the tracking interface card into option slot 1 (OPT1) and the built-in vision sensor card into option slot 2 (OPT2) simplifies the wiring.

5.1 Installing the tracking interface card

5.1.1 For CR1-571 controller

The tracking interface card can install to option slot 1(OPT1) or option slot 2(OPT2) in the expansion option box.

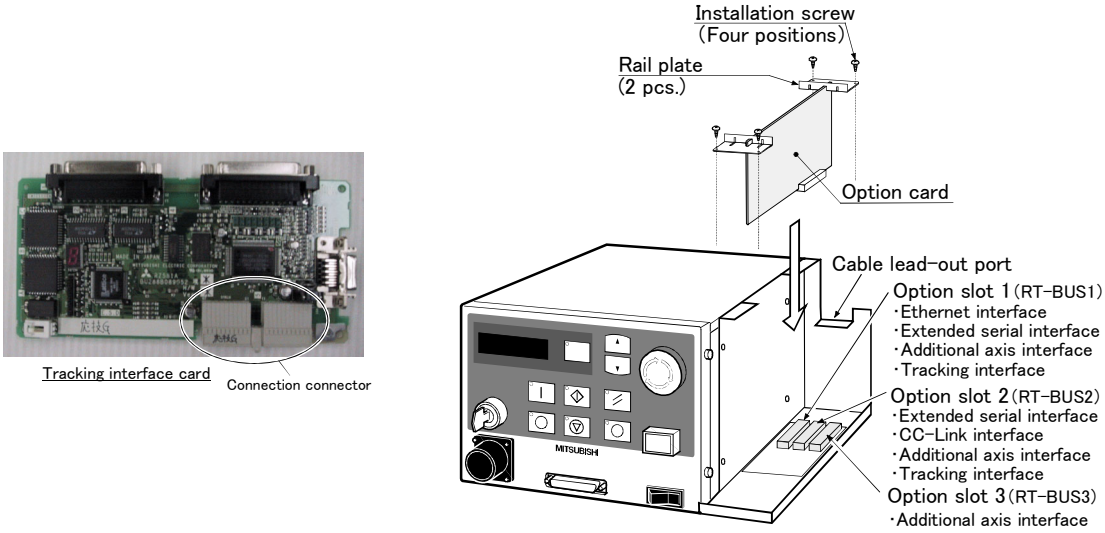


Fig.5-1 : Installing the tracking interface card (CR1-571 controller)

5.1.2 For CR2A-572 controller

The tracking interface card can install to option slot 1(OPT1) or option slot 2(OPT2) in the controller.

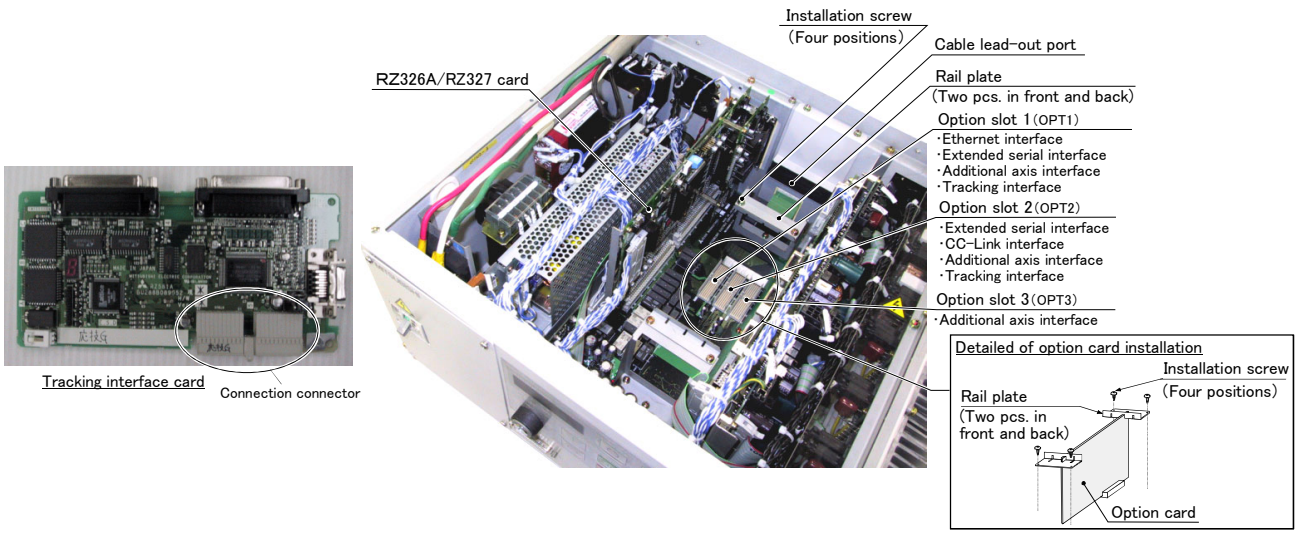


Fig.5-2 : Installing the tracking interface card (CR2A-572 controller)

6 Connecting the devices

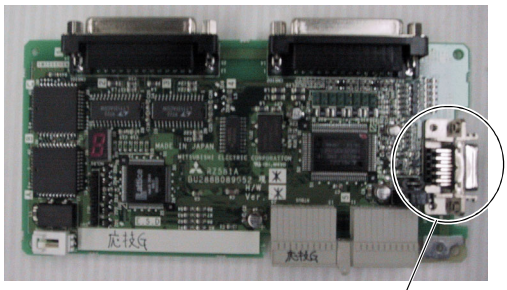
The following shows a connection example of a conveyor encoder and a photoelectric sensor.
If other devices such as a built-in vision sensor are used, connect the required devices by referring to the instruction manual that comes with each option card.

6.1 Connecting the conveyor encoder

Fig. 6-1 shows the connection diagram (example) of the connector of the tracking interface and encoder. The figure shows a case where E6B2-CWZ1X (made by Omron) is used for the encoder and is connected to channel 1 (CH1) of the tracking interface. Up to two encoders can be connected to one tracking interface.
Eight signal wires are required for the connection: for power supply (+ side and − side) and + and − sides of the A, B and Z phases of the differential encoder. Connect the signal wires correctly by referring to the manual of the encoder to be used.

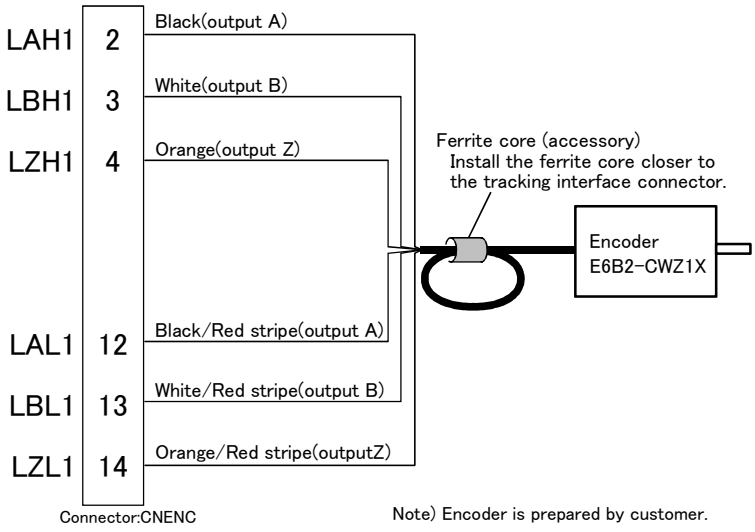
Please note that if you use two encoders, for example when using two conveyers, each of the encoders should be connected to CH1 and CH2 of the tracking interface, respectively. Please refer to "Appendix 3 : Connector pin assignments of tracking interface" on page 32, which shows the connector pin assignment, when connecting an encoder to CH2.

⚠ CAUTION Make sure to mount the ferrite core that comes with the product at the tracking interface connector end of the encoder cable. If the ferrite core is not mounted, the robot may malfunction due to the influence of noise.



Tracking interface card

Connector : CNENC



The example of connection to the tracking interface card CH1

The signal name and specification of CH1

LAH1 ..... Differential encoder A phase signal + side
LBH1 ..... Differential encoder B phase signal + side
LZH1 ..... Differential encoder Z phase signal + side
+5V..... Differential encoder A phase signal + side
LAL1..... Differential encoder A phase signal − side
LBL1..... Differential encoder B phase signal − side
LZL1..... Differential encoder Z phase signal − side
SG..... Differential encoder A phase signal + side

Fig.6-1 : Connection of encoder input

6.2 Connecting the photoelectric sensor

If a photoelectric sensor is used to detect the presence of workpieces, connect its signal to the number assigned by the customer among the general-purpose input signals of the robot controller. Fig. 6-2 shows a connection example when the signal of the photoelectric sensor is assigned to number 6 of the general-purpose input signals.

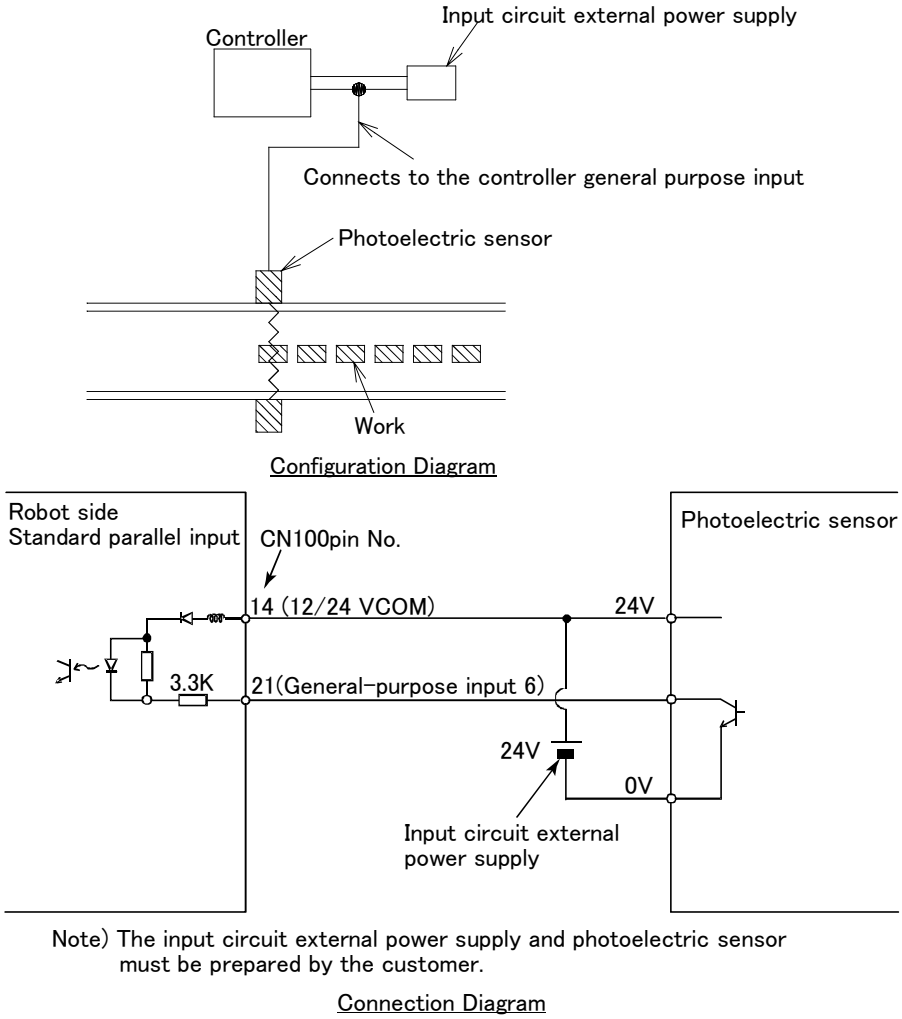


Fig.6-2 : Connection Example of Photoelectric Sensor (general-purpose input 6)

7 Setting of the software

7.1 The required setting item

Shown in the following to the setting method and the set item required for tracking operation.

7.1.1 Parameter: Setting the EXTENC

(1) Outline

Set which channel of the tracking interface the encoder of the conveyor is connected to. Two encoders can be connected to one tracking interface card. (2 channels are provided.) Set other related parameters as necessary. For a list of relevant parameters, refer to "Appendix 1 : Related parameter" on page 28.

(2) Setting method

Set the correspondence between the connection destinations to the tracking interface and the encoder numbers (1 to 8) handled by the robot program. The number of elements is 8; set the connection destinations for encoder number 1, encoder number 2, .., encoder number 8 using a number between 1 to 4 in ascending order.

Table 7-1 : Parameter: EXTENC

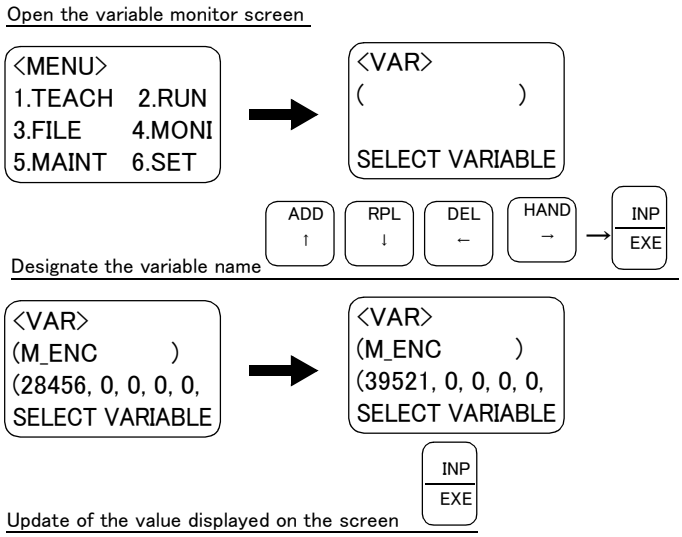
Parameter	Parameter name	No. of arrays No. of characters	Details explanation	Factory setting
External encoder	EXTENC	Integer 8	Set the correspondence between the connection destinations to the tracking interface and the encoder numbers (1 to 8) handled by the robot program. The number of elements is 8; set the connection destinations for encoder number 1, encoder number 2, .., encoder number 8 using a number between 1 to 4 in ascending order. Input and set the number from 1 to 4 shown below into the parameter value. "1": Connect to the CH1 in the wearing slot 1. "2": Connect to the CH2 in the wearing slot 1. "3": Connect to the CH1 in the wearing slot 2. "4": Connect to the CH2 in the wearing slot 2.	1,2,3,4,1,2,3,4

Example) Assigning encoder number 1 to the encoder connected to channel 1 (CH1) of the tracking interface mounted in option slot 2. EXTENC=(3, 0, 0, 0, 0, 0, 0, 0)

Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the setting operation the parameter.

(3) Confirmation of the setting

Verify the correct encoder connection and parameter settings by observing the change in the status variable of the robot, M_ENC value. This operation is performed with the teaching pendant. Set the teaching pendant [ENABLE/DISABLE] switch to "ENABLE".



1) Display the M_ENC value on the variable monitor screen of the teaching pendant. The number of elements for this variable is 8; the encoder pulses for encoder number 1, encoder number 2, .., encoder number 8 are stored in the ascending order.

2) Operate the conveyor.

3) Press the [INP/EXE] key of the teaching pendant. Among the values displayed on the screen, if the numeric values of the encoder numbers set by the parameter have changed, both the settings and connection are correct. Note that the values displayed on the screen are updated every time the [INP/EXE] key is pressed. In the example at left, the value of encoder number 1 has changed.

Completes the confirmation of the setting of the EXTENC of parameter.

7.1.2 Calibration of the conveyor

(1) Outline

"Calibrating the conveyor" means determining the conversion coefficient for calculating how much the conveyor has traveled based on the relationship between the traveling direction of the conveyor relative to the coordinate system of the robot, and from the difference in the encoder pulses from a certain moment. Set the conversion coefficient in P_ENCDLT, which is a status variable of the robot. This can be set using a sample program that comes with the product. Prepare the following devices and jig, etc.

[Preparation goods]

- Floppy disk of sample program (accessories)
- Marking seal for calibration (accessories)
- The personal computer set that installed the "Personal Computer Support Software"(provided by the customer)
- Calibration jig (provided by the customer)

(2) Setting method

The following shows the setup procedure using the sample program "A.prg" that comes with the product.
For more information about the detailed operating procedure of Personal Computer Support software, refer to the separate document entitled "Instruction Manual/Personal Computer Support Software." For more information about the detailed operating procedure of the teaching pendant, refer to the separate document entitled "Instruction Manual/Detailed Explanation of Functions and Operations."
Also, see a list of the sample programs in "(1)Conveyor calibration: A.PRG" on page 29.

1) Mount the calibration jig (hereafter referred to as the jig) to the mechanical interface of the robot. Also, connect a personal computer on which Personal Computer Support software has been installed to the robot controller.
2) Determine the teaching position on the conveyor, and paste a marking label for calibration.

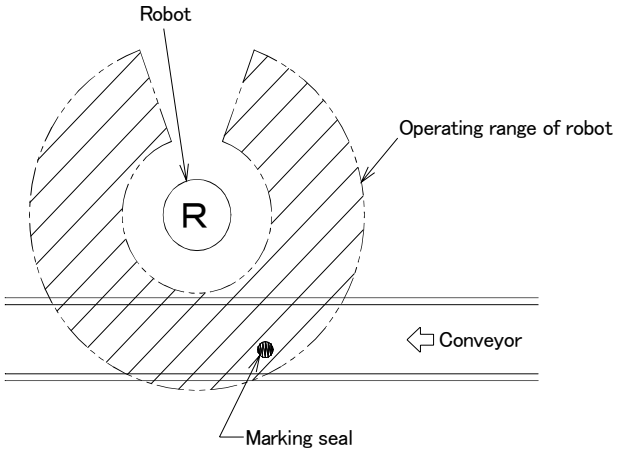


Fig.7-1 : Teaching position on the conveyor

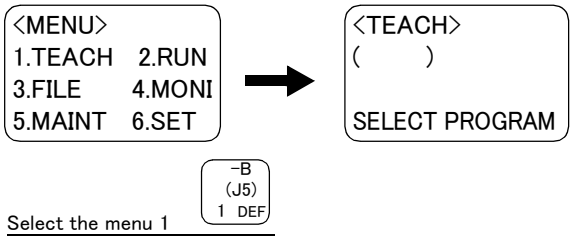
3) Using the personal computer support software, load the sample program "A.prg" to the robot controller. Use the unused number for the program number.

4) Move the robot for jog operation, and match the tip of the calibration jig with the marking-seal pasted by the above "2)".

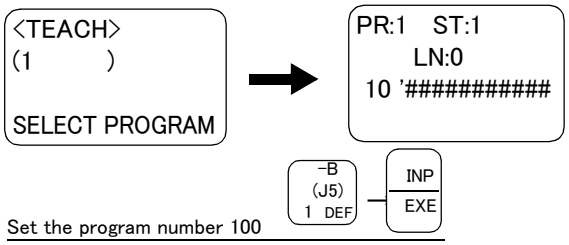
◇◆◇ The positional relationship with the conveyor is important ◇◆◇

This position is used for teaching even after the conveyor has moved.
In order to calibrate correctly, teach so that the distance between the conveyor and the jig (normally the height in the Z axis direction) becomes the same.
Also, if a vertical joint type robot is used, adjust the flange surface of the robot so that it is parallel to the conveyor.

5) Execute the program transferred in "3)" above in steps while the robot is being aligned with the marking label.
The following describes the procedure.

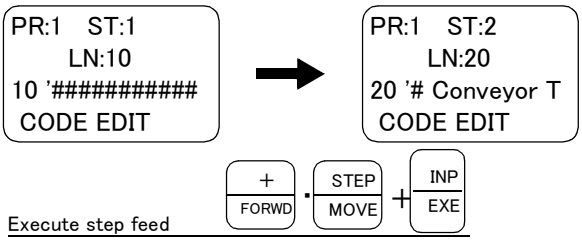


Press the [1] key. The PROGRAM SELECTION screen will appear.



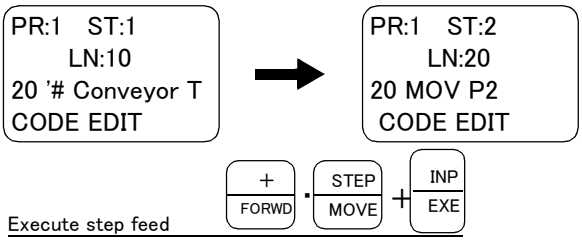
Set "1" for the program name, and display the edit screen of program 1.
(When it transmits to the program number 1.)
The first line will be displayed.

Program display : 10 ' ##########################



While holding down the [FORWD] key or [STEP] key, hold down the [EXE] key. The line number 10 displayed on the screen is executed, then next line will be displayed.

Program display : 20 '# Conveyor Tracking



Press the EXE key once again and hold it pressed again. Execute line number 20 and display the next line on the screen.
Repeat this operation to execute up to line number 120.
With the operation above, the conveyer's encoder pulse and robot position are read into variables.

Program display : 130 '(4)Move the conveyor forward

(6) Raise the robot once by a jog operation, and move it away from the conveyor.
(7) Move the conveyor in the forward rotation within the range where the marking label on the conveyor stays inside the operating range of the robot.
(8) Move the robot by a jog operation again, and align the tip of the jig with the marking label in same way as 4) above.
At this time, adjust the positional relationship of the robot relative to the conveyor as described above so that the same point as the first teaching point can be obtained.
(9) Press the [EXE] key while holding down the [FORWD] key or the [STEP] key, and execute from the subsequent step of the program in steps. Repeat the key operation until the END command on the 220th line is executed.
With this operation, the positional relationships among the mounting position and traveling direction of the conveyor, and the traveling direction of the conveyor relative to the encoder pulses are established.

This concludes the calibration of the conveyor. Raise the robot by a jog operation.

7.1.3 Calibration of vision sensor

If a built-in vision sensor is used, perform the calibration of the vision sensor.
Please relate the coordinates system between the robot and vision sensor based on the application.

7.1.4 Teaching of the Reference Positions

(1) Outline

This section describes the teaching of the reference positions in order to facilitate their detections using actual workpieces, on the assumption that a system uses a photoelectric switch as a trigger for workpiece detection. Teaching can be implemented using a sample program in the same way as described in Section "7.1.2Calibration of the conveyor". The reference positions have been set in the external variable (P_03) of the robot in a sample program, so that they can be used by other programs. Prepare the following devices, workpiece, etc. prior to this operation.

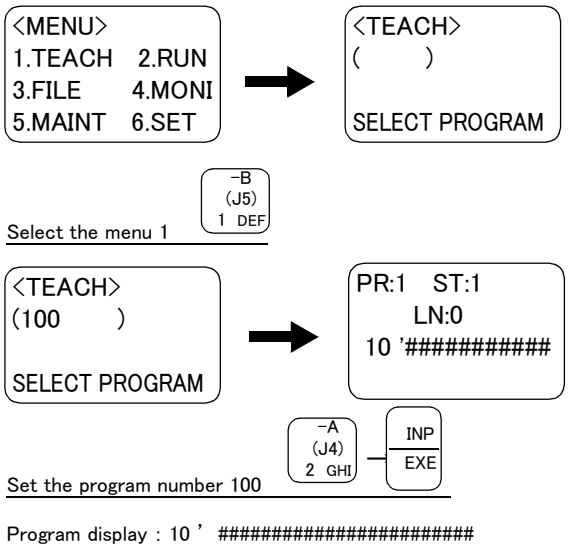
[Preparation goods]

- Floppy disk of sample program (accessories)
- The personal computer set that installed the "Personal Computer Support Software"(provided by the customer)
- Robot hand (provided by the customer)
- Workpieces to be used in actual operation (provided by the customer)

(2) Setting method

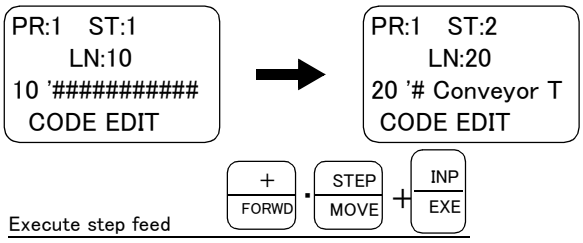
The following shows the setup procedure using the sample program "CV0.prg" that comes with the product.
For more information about the detailed operating procedure of Personal Computer Support software, refer to the separate document entitled "Instruction Manual/Personal Computer Support Software." For more information about the detailed operating procedure of the teaching pendant, refer to the separate document entitled "Instruction Manual/Detailed Explanation of Functions and Operations."
Also, see a list of the sample programs in "(2)Teaching of the reference position.: CV0.PRG" on page 30.

1) Mount the hand to be used in an actual operation to the mechanical interface of the robot. Connect the personal computer in which the personal computer support soft ware installed to robot controller.
2) Using the personal computer support software, load the sample program "CV0.prg" to the robot controller. Use the unused number for the program number.
3) Place the workpiece to be actually used on the conveyor. Move the conveyor and stop it at the position where the photoelectric switch detects the workpiece.
4) Execute the program transferred in "1)" above in steps. The following describes the procedure.



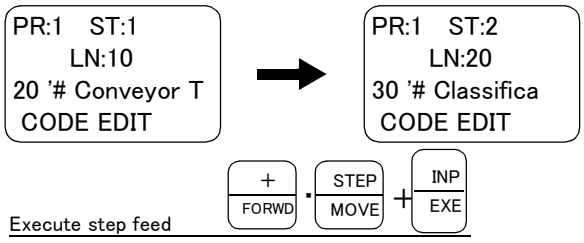
Press the [1] key. The PROGRAM SELECTION screen will appear.

Set "2" for the program name, and display the edit screen of program 2.
(When it transmits to the program number 2.)
The first line will be displayed.



Program display : 20 '# Conveyor Tracking

While holding down the [FORWD] key or [STEP] key, hold down the [EXE] key. The line number 10 displayed on the screen is executed, then next line will be displayed.



Program display : 30 '# Classification of program

Press the EXE key once again and hold it pressed again. Execute line number 20 and display the next line on the screen.
Repeat this operation to execute up to line number 90.
With the operation above, the conveyer's encoder pulse and robot position are read into variables.

5) Move the conveyor so that the workpiece comes within the operating range of the robot.
6) Move the robot by a jog operation, and adjust at the position where the robot actually grips the workpiece.
7) Press the [EXE] key while holding down the [FORWD] key or the [STEP] key, and execute from the subsequent step of the program in steps. Repeat the key operation until the END command on the 210th line is executed.

This concludes the teaching of the reference positions. Raise the robot by a jog operation.

8 Confirmation of movement

8.1 Verifying the settings

Execute the sample program "TTR0.prg," and verify that the connection of each device and the required settings are made correctly. The robot tracks the movement of the conveyor, and operates only five seconds in parallel with the conveyor in this operation. (The current position of the robot changes.)

⚠ CAUTION

The robot and the conveyor operate in this operation.
Before starting automatic operation, always confirm the following items. Starting auto-matic operation without confirming these items could lead to property damage or physi-cal injury.

- Make sure that there are no operators near the robot.
- Make sure that the safety fence is locked, and operators cannot enter unintention-ally.
- Not place unnecessary things in the robot's operating range or on conveyor.

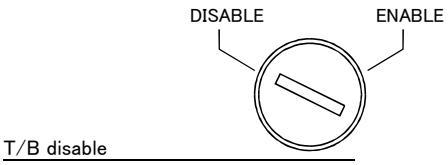
1) Using the personal computer support software, load the sample program "TTR0.prg" to the robot controller. Use the unused number for the program number.
2) Move the robot toward the upstream of the conveyor by a jog operation. When the sample program is exe-cuted, the robot tracks the movement of the conveyor from this position, and operates only five seconds in parallel with the conveyor.

[Caution] Because the operating range is not checked by the sample program, the robot may be positioned out of its operating range during 5-second tracking, depending on the operating speed of the conveyor and, as a result, an H2160 (joint limit over) alarm may be generated. In this case, press the [RESET] key on the operation panel at the front of the controller to cancel the alarm.
The tracking time is set on the 100th line of the sample program.
100 DLY 5.0 ;5-second timer

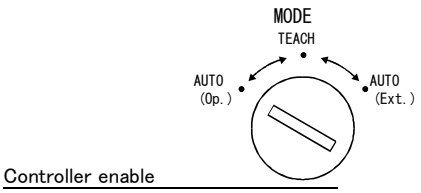
The tracking time can be changed by changing this setup value.
Also, see a list of the sample programs in "(3)Confirmation of movement: TTR0.PRG" on page 31.
Change of the setting value is made by the program edit screen of the teaching pendant. For more information about the detailed operating, refer to the separate document entitled "Instruction Manual/ Detailed Explanation of Functions and Operations."

3) Execute the program transferred in "1)" above in steps. The following describes the procedure.

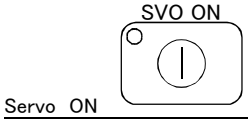
Prepare the controller



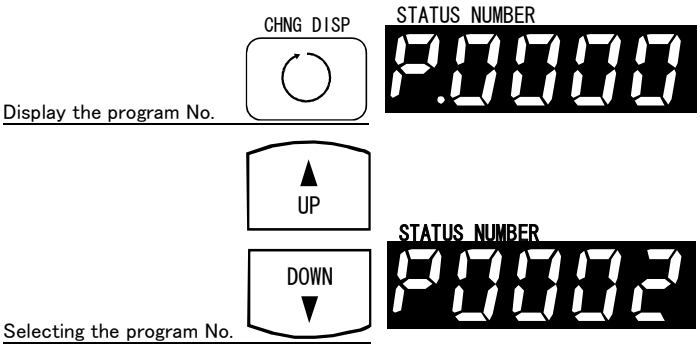
Set the T/B [ENABLE/DISABLE] switch to "DIS-ABLE", and set the controller [MODE] switch to "AUTO (Op.)".



The robot's servo is turned off once; press the [SVO.ON] button on the controller to turn it on.



Selecting the program No.



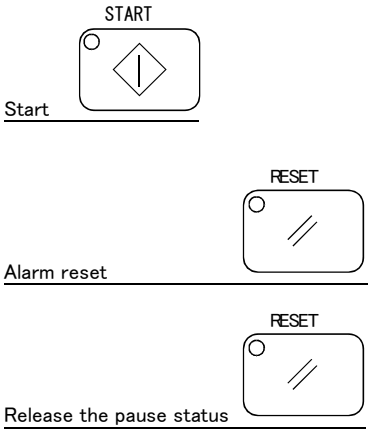
Press the [CHANG DISP] switch on the controller to display "Program Number" on the STATUS NUMBER display panel.

Press the [UP] and [DOWN] switches on the controller to display the program number of the sample program loaded in step "1)" above.

In the example to the left, program number 2 is displayed.

Operate the conveyor.

Starting automatic operation



Press the controller [START] switch.
The robot operates in parallel with the conveyor, following the movement of the conveyer.
If the robot operates in parallel with the conveyor, the calibration settings of the conveyor are appropriate.

If the robot continues a tracking operation and is positioned out of its operating range, an H2160 (joint limit over) alarm is generated.
If an alarm is generated, press the [RESET] button on the controller to cancel the alarm, and press the [RESET] button again to cancel the halt state of the program.

Now confirmation of the calibration setting status of the conveyer is completed.

9 Explanation of the command

A list of instructions, status variables and functions related to tracking operations is shown below.
For further information related to MELFA-BASIC Ⅳ , please refer to "Instruction Manual/Detailed Explanation of Functions and Operations" of the separate volume.

9.1 List of Instructions

Table 9-1 : List of Instructions

Command name	Functions
TRK	Define the start and end of tracking mode.
TRBASE	Specify the workpiece's coordinate system origin for teaching data and the external encoder logic number for tracking.
TRWRT	The work data is written in the tracking data buffer.
TRRD	The work data is read from the tracking data buffer.
TROUT	The encoder input data is read out, being accompanied with output from the general-purpose output.
TRCLR	Clear of tracking data buffer.

9.2 List of status variables

Table 9-2 : List of status variables

Variable name	Matrix assignment	Content	Read/write attribute Note1)	Type
M_ENC	8 (Number of encoders)	External encoder data.	R/W	Double precision real number
M_ENCMAX	8 (Number of encoders)	Max. value of the external encoder data	R	Double precision real number
M_ENCMIN	8 (Number of encoders)	Min. value of the external encoder data	R	Double precision real number
P_ENCDLT	8 (Number of encoders)	Data to convert the number of encoder pulses to the movement amount	R/W	Position
M_ENCSPD	8 (Number of encoders)	External encoder speed [pulse/sec]	R	Single precision Real number
P_CVSPD	8 (Number of encoders)	Conveyor speed [mm, rad/sec]	R	Position
M_TRKCQ (Mechanism No.)	8	1 when the designated mechanism tracks, and 0 when it does not track.	R	Integer
M_TRBFCT	8 (Number of buffers)	Data stored in the buffer	R	Integer

Note1) R .....Only reading is possible.
R/W..Both reading and writing are possible.

9.3 List of functions

Table 9-3 : List of functions

Function name	Function	Result
POSCQ(<Psition>)	Whether the <position> is in the working range of the robot is checked. 1 when it is in the working range, and 0 when it is outside the working range	1/0
TRWCUR(<Encoder No.>, <Position>, <Encoder No.>)	The current position of the workpiece is gained.	Position
TRPOS(<Position>)	Position in the world coordinate system in the tracking mode. TRK ON P0, P1, 1, M_E, PC2=TRPOS(P2) PC2 above is gained from the following. PC1=P1+P_ENCDLT*(M_ENC-M_E) Current position of P1 PC2=PC1*(P_ZERO/P0*P2)4	Position
ENCADD(<Encoder No.>, <Encoder value>, <Encoder value 2>)	The encoder value is added. <Encoder value 1> + <Encoder value 2> - <Maximum value>, if the max. value of the encoder value is exceeded.	Double precision real number
ENCSUB(<Encoder No.>, <Encoder value>, <Encoder value 2>)	The encoder value is subtracted. <Encoder value 1> - <Encoder value 2> + <Minimum value>, if the difference is less than the min. value of the encoder.	Double precision real number

9.4 Explanation of commands for tracking operation

Details of instructions related to tracking operations are explained below.

TRK

[Function]

During the time from TRK ON execution to TRK OFF execution, the tracking mode is activated to operate the robot, tracking the operation of the conveyor.

[Format]

TRK ON [,<Measurement position data>[,[<Encoder data>][<Reference position data>][,[,<Encoder logic No.>]]]]

TRK OFF

[Terminology]

<Measurement position data>	The workpiece position measured with the sensor is designated.
<Encoder data>	When the workpiece is measured, the value of the encoder installed on the conveyor is designated.
<Reference position data>	The position data in the tracking mode is converted to the relative position with this data regarded as the origin. If it is omitted, the previously designated value is selected. The default value is P_ZERO.
<Encoder logic No.>	Logic No. of external encoder which operates the tracking operation. 1 when it is omitted, and the maximum value is 8.

[Sentence example]

```
10 TRBASE P0              ' The origin in the workpiece coordinate system of the teaching position is designated.
20 TRRD P1, M1, M_KIND    ' The workpiece position data is read from the data buffer.
30 TRK ON , P1, M1        ' Tracking is started against the workpiece in which the measurement position is
                            P1 and the value of the encoder during the measurement is M1.
40 MVS P2                 ' If the current position of P1 is regarded as P1 c, the robot is operated, regarding
                            P1c *P_ZERO/P0*P2 as the target position and tracking the workpiece.
50 HCLOSE 1               ' The hand is closed.
60 TRK OFF                'The tracking operation is ended.
```

[Explanation]

- The target position of the movement command during tracking operation is described the relative position against the position data designated by TRK ON as shown on the 20th line of the sentence example.
- The 30th and 40th lines of the sentence example above can be also rewritten as shown below.

```
30 TRK ON , P1, M1, P0
40 MVS P2
```

In this example, P2 in the 40th line is regarded as the relative position from P0.

TRBASE

[Function]

The logic No. of the external encoder used for the workpiece coordinate system origin and the tracking operation during teaching is designated.

[Format]

TRBASE <Reference position date> [, <Encoder logic No.>]

[Terminology]

<Reference position data> The position data in the tracking mode is converted into the relative position in which the data is regarded as the origin.
<Encoder logic No.> It is the logic No. of the external encoder which does the tracking operation. If it is omitted, it is "1".

[Sentence example]

```
10 TRBASE P0                ' The origin in the workpiece coordinate system of the teaching position is designated.
20 TRRD P1, M1, M_KIND      ' The workpiece position data is read from the data buffer.
30 TRK ON , P1, M1          ' Tracking is started against the workpiece in which the measurement position is P1 and the value of the encoder during the measurement is M1.
40 MVS P2                   ' If the current position of P1 is regarded as P1 c, the robot is operated, regarding P1c *P_ZERO/P0*P2 as the target position and tracking the workpiece.
50 HCLOSE 1                 ' The hand is closed.
60 TRK OFF                  ' The tracking operation is ended.
```

[Explanation]

- The logic No. of the external encoder used for the workpiece coordinate system origin and the tracking operation during teaching is designated.
- If the logic No. of the encoder is omitted, the last designated value is used.
- Each default value is P_ZERO is "1" until <Reference position data> and <Encoder logic No.> are designated with the argument of TRBASE, TRK ON in the program.

TRWRT, TRRD

[Function]

The position data for tracking operation, encoder data and others are written and read into/from the data buffer.

[Format]

TRWRT <Position data> [,[<Encoder data>][,[<Product type No.>][,[<Buffer No.>][,<Encoder No.>]]]]

TRRD <Position data> [,[<Encoder data>][,[<Product type No.>][,[<Buffer No.>][,<Encoder No.>]]]]

[Terminology]

<Position data>	The workpiece position measured with the sensor is written/read.
<Encoder data>	The value of the encoder installed on the conveyor to measure the workpiece is written/read.
<Product type No.>	The product type No. of the workpiece is written/read. It is designated in the range of 1 to 65535.
<Buffer No.>	The data buffer No. is set. If it is omitted, it is "1". The maximum No. is 8.
<Encoder No.>	The external No. encoder is written/read. If it is omitted, the same as the buffer No. The maximum No. is 8.

[Sentence example]

(1) Tracking work program

```
10 TRBASE P0                ' The origin in the workpiece coordinate system of the teaching position is designated.
20 TRRD P1, M1, M_KIND      ' The workpiece position data is read from the data buffer.
30 TRK ON , P1, M1          ' Tracking is started against the workpiece in which the measurement position is P1 and the value of the encoder during the measurement is M1.
40 MVS P2                   ' If the current position of p1 is regarded as P1 c, the robot is operated, regarding P1c *P_ZERO/P0*P2 as the target position and tracking the workpiece.
50 HCLOSE 1                 ' The hand is closed.
60 TRK OFF                  ' The tracking operation is ended.
```

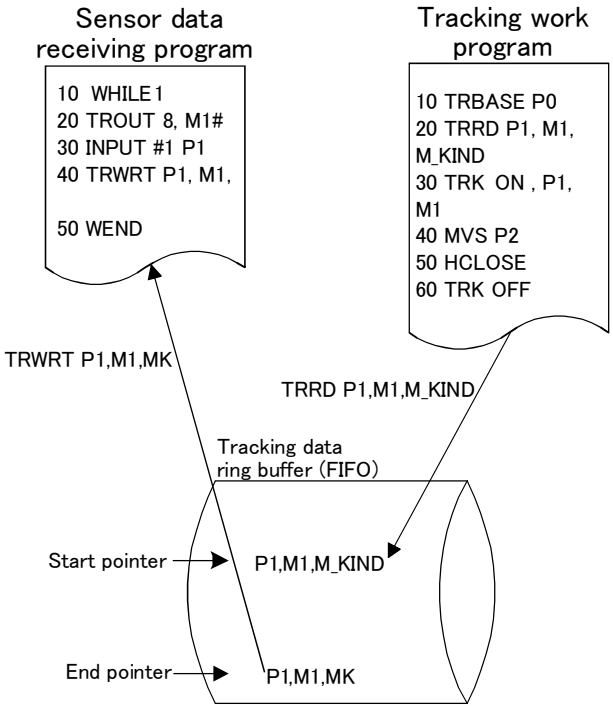
(2) Sensor data receiving program

```
10 WHILE 1
20 TROUT 8, M1#             ' The output No. 8 is output to apply the trigger to the vision sensor, and the value of the external encoder at that time is set at M1.
30 INPUT #1, P1             ' The workpiece position data sent from the sensor is read into P1.
40 TRWRT P1, M1, MK         ' The workpiece position data, photoed encoder value and product type are written in the buffer.
50 WEND
```

[Explanation]

- If the encoder data is omitted, it operates, tracking the variation of the position data.
- If TRRD is executed when any data is not present in the data buffer, P_ZERO is set at the position data.
- If the buffer No. is omitted, it is "1".
- Even if any data of the same workpiece is written in the data buffer twice with TRWRT, only one is stored in the buffer. Accordingly, even if the same workpiece is photoed twice with the vision sensor and the data are written, only one data is read with TRRD.

The flow of the data is shown below.



TRCLR

[Function]
Tracking data buffer is cleared.

[Format]

TRCLR <Buffer No.>

[Terminology]

<Buffer No.>	No. of general purpose output is designated.

[Sentence example]

```
10 TRCLR 1                  ' The tracking data buffer No.1 is cleared.
20 WHILE 1
30 TROUT 8, M1#             ' The output No.8 is output to apply the trigger to the vision sensor, and the value
                              of the external encoder at that time is set at M1.
40 INPUT #1, P1             ' The workpiece position data sent from the sensor is read into P1.
50 TRWRT P1, M1, MK         ' The workpiece position data, photoed encoder value and product type are writ-
                              ten in the buffer.
60 WEND
```

[Explanation]
・When the tracking program is initialized, it is executed to clear the data buffer.

TROUT

[Function]

The output designated as the general-purpose output is output, and the value of the external encoder is read in synchronization with the output.

[Format]

TROUT <Output No.>, <Encoder value read variable> [,<Encoder logic No.>]

[Terminology]

<Output No.>	No. of general purpose output is designated.
<Encoder value read variable>	The double precision value variable to set the external encoder read value is designated.
<Encoder logic No.>	No. of the external encoder to be read is designated. When it is omitted, it is "1".

[Sentence example]

```
30 GOTO 10
10 IF M_IN(10) <> 1 GOTO 10      ' Whether the photoelectric sensor is ON or not is checked.
20 TROUT 20, M2#                 ' It is output from the general-output No.20, and the value of the external
                                   encoder No.1 is set at M2 in synchronization with the output.
30 GOTO 10
```

[Explanation]

- It is used to apply the photoing trigger to the vision sensor which measures the position of the workpiece to which the tracking work is done.
- The photoed position of the workpiece can be known by retrieving the value of the external encoder in synchronization with the output.

10 Appendix

Appendix 1 : Related parameter

The parameter about the tracking is shown in the Table 10-1.
External encoder: The setup of EXTENC is necessary. Sets up of the other if needed.

Table 10-1 : Related parameter

Parameter	Parameter name	No. of arrays No. of characters	Details explanation	Factory setting
External encoder	EXTENC	Integer 8	Set the correspondence between the connection destinations to the tracking interface and the encoder numbers (1 to 8) handled by the robot program. The number of elements is 8; set the connection destinations for encoder number 1, encoder number 2, .., encoder number 8 using a number between 1 to 4 in ascending order. Input and set the number from 1 to 4 shown below into the parameter value. "1": Connect to the CH1 in the wearing slot 1. "2": Connect to the CH2 in the wearing slot 1. "3": Connect to the CH1 in the wearing slot 2. "4": Connect to the CH2 in the wearing slot 2.	1,2,3,4,1,2,3,4
Min. value of the external encoder data	ENCRGMN	Integer 8	Min. value of the external encoder data	
Max. value of the external encoder data	ENCRGMX	Integer 8	Max. value of the external encoder data	
Tracking buffer	TRBUF	Integer 2	Tracking buffer number and size.	
The judgment distance of the tracking workpiece	TRCWDST	Real value 1	The judgment distance of the same tracking workpiece. (mm)	
Tracking adjustment coefficient 1.	TRADJ1	Real value 8	Tracking adjustment coefficient 1. The delay amount is converted into the conveyor speed of 100mm/s and set. Example) ・For example, it delayed 2mm at the speed of 50mm/s, Set value = 4.0 (2/50*100) ・For example, if advance is 1mm at the speed of 50mm/s, Set value = -2.0 (-1/50*100)	
Tracking adjustment coefficient 2.	TRADJ2	Real value 8	Tracking adjustment coefficient 2. If the conveyor speeds are regarded as Vc and Vp at the last and current sampling times, correct Vc to Vc+TRADJ2 * (Vc-Vp). Vc= The speed of the conveyor at last sampling time. Vp= The speed of the conveyor at this sampling time.	
Communication setting Note1)			Communication environment is set for RS-232C in the front of the robot controller.	
	COMDEV	Character string 8	This configures which lines will be assigned to COM1 and COM2 when using communication lines in the OPEN instruction in MELFA BASIC IV.	
	CBAU232	Integer 1	Setting the baud rate.	
	CPRTY232	Integer 1	Setting the parity bit.	
	CSTOP232	Integer 1	Setting the stop bit.	
	CTERM232	Integer 1	Setting the end code.	
	CPRC232	Integer 1	Setting the communication method(protocol).	

Note1)The parameter setting of RS-232C installed on the front of the controller is shown in this table. This is used by the Personal computer support software, this normally does not need to be changed.
When connecting vision sensors,etc., use of optional expansion serial interface is recommended.
Perform the setup of RS-232C of the tracking interface with reference to "INSTRUCTION MANUAL/ Expansion Serial Interface" of the separate volume.

Appendix 2 : Details of the sample program

(1) Conveyor calibration: A.PRG

```
10 '########################################################################
20 '# Conveyor Tracking  Calibration processing between robot-conveyors
30 '# Classification of program      : RB-CV Calibration Program
40 '# Version : A0a
50 '# COPYRIGHT : MITSUBISHI ELECTRIC CORPORATION.
60 '########################################################################
70 '(1)Stick the marking seal to the upper course of the conveyor
80 '(2)Move the robot to center of the seal
90   MX10EC1#=M_ENC 'Get the encoder data 1
100   PX10PS1=P_FBC  'Get the position 1
110 '
120 '(3)Move the robot up
130 '(4)Move the conveyor forward
140 '(5)Move the robot to center of the seal again
150   MX10EC2#=M_ENC 'Get the encoder data 2
160   PX10PS2=P_FBC  'Get the position 2
170   P_101(1)=PX10PS2
180 '(6)Move the robot up
190 '(7)Execute by step execution till END
200   GOSUB *S10ENC 'Calculation processing of P_ENCDLT
210   P_ENCDLT=PY10ENC
220 END
230 '
240 '##### Calculation processing of P_ENCDLT #####
250    'MX10EC1:Encoder data 1
260    'MX10EC2:Encoder data 2
270    'PX10PS1:Position 1
280    'PX10PS2:Position 2
290    'PY10ENC:Value of P_ENCDLT
300 *S10ENC
310   M10ED#=MX10EC2#-MX10EC1#
320   IF M10ED#>800000000.0 THEN M10ED#=M10ED#-1000000000.0
330   IF M10ED#<-800000000.0 THEN M10ED#=M10ED#+1000000000.0
340   PY10ENC.X=(PX10PS2.X-PX10PS1.X)/M10ED#
350   PY10ENC.Y=(PX10PS2.Y-PX10PS1.Y)/M10ED#
360   PY10ENC.Z=(PX10PS2.Z-PX10PS1.Z)/M10ED#
370   PY10ENC.A=(PX10PS2.A-PX10PS1.A)/M10ED#
380   PY10ENC.B=(PX10PS2.B-PX10PS1.B)/M10ED#
390   PY10ENC.C=(PX10PS2.C-PX10PS1.C)/M10ED#
400 RETURN
PX10PS1=(+255.273,-209.923,+24.897,+0.000,+0.000,+83.560)(0,0)
PX10PS2=(+256.937,+162.904,+24.999,+0.000,+0.000,+83.560)(0,0)
PY10ENC=(+0.000,+0.050,+0.000,+0.000,+0.000,+0.000,+0.000,+0.000)
```

(2) Teaching of the reference position.: CV0.PRG

```
10 '#####################################################
20 '# Conveyor Tracking Calibration processing for the photoelectric sensor(No vision sensor)
30 '# Classification of program      : RB-VS Calbration program (No vision sensor)
40 '# Version : A0a
50 '# COPYRIGHT : MITSUBISHI ELECTRIC CORPORATION.
60 '#####################################################
70 'PVS:  X:Longer distance of VS screen size/Y:Longer distance of workpiece size/Z:Trigger signal number
(Default=340,270,4)
80 '(1)Move the workpiece until the photoelectric sensor turns on
90   ME1#=M_ENC  'Get the encoder data 1
100 '(2)Move the conveyor forward until the workpiece comes in the robot's operation area
110 '(3)Move the robot to the adsorption position
120   ME2#=M_ENC 'Get the encoder data 2
130   P_100(1)=P_FBC 'Get the position
140 '
150   MED#=ME2#-ME1#
160   IF MED# > 800000000.0 THEN MED# = MED#-1000000000.0
170   IF MED# < -800000000.0 THEN MED# = MED#+1000000000.0
180 '
190   M_01#=MED#
200   P_03=PVS 'Store the parameter in the external variable
210 END
PVS=(+340.000,+105.000,+4.000,+0.000,+0.000,+0.000)
```

(3) Confirmation of movement: TTR0.PRG

```
10 '#####################################################
20 '# Conveyor Tracking Check operation of the photoelectric sensor (No vision sensor)
30 '# Classification of program      : RB-VS Calbration program (No vision sensor)
40 '# Version : A0a
50 '# COPYRIGHT : MITSUBISHI ELECTRIC CORPORATION.
60 '#####################################################
70 '
80 '(1)Tracking of the robot's current position
90   TRK ON
100  DLY 5.0
110  TRK OFF
120  END
```

Appendix 3 : Connector pin assignments of tracking interface

The connector layout of tracking interface is shown in Fig. 10-1 and connector pin assignment is shown in Table 10-2, Table 10-3, and Table 10-4.

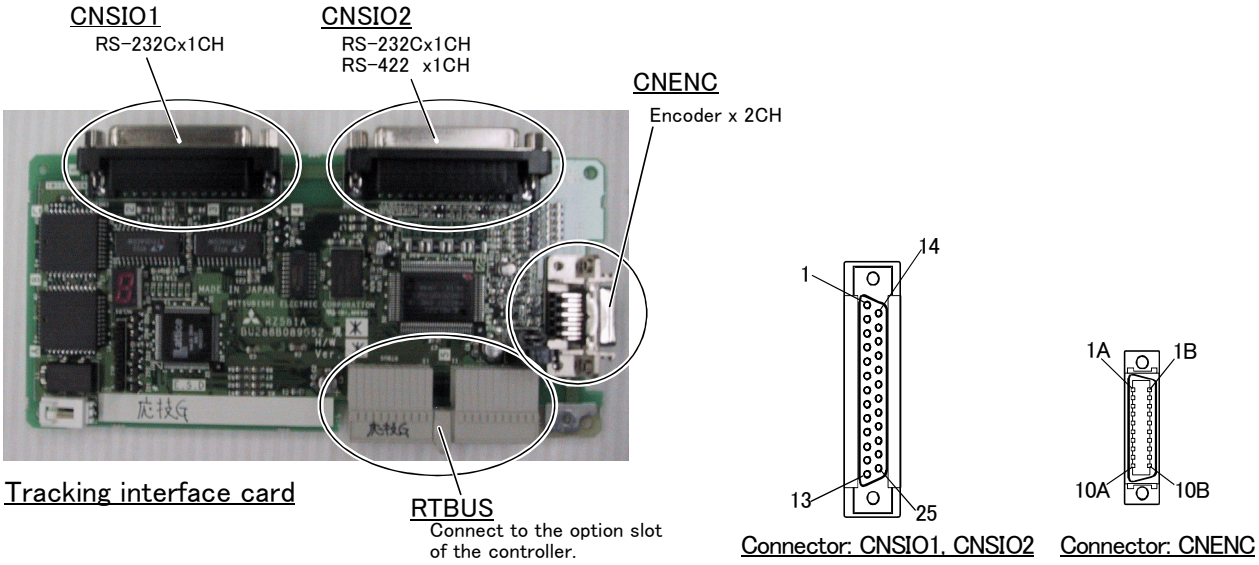


Fig.10-1 : Position of connector

Table 10-2 : Connector: CNSIO1 pin assignments

Pin No.	Signal name	Explanation	Input/ Output	Remarks
2	TXD	The transmitted data to external equipment.	Output	RS-232C
3	RXD	The received data from external equipment.	Input	
4	RTS	Request To Send.	Output	
5	CTS	Clear To Send.	Input	
6	DSR	Data Set Ready.	Input	
20	DTR	Data Terminal Ready.	Output	
7	SG	Control power supply 0V.	-	
1	FG	Ground (Connecting the shield of the cable).	-	
8	DCD	Receiving carrier detect.	Input	
22	RI	Ring Indicator.	Input	

Table 10-3 : Connector: CNSIO2 pin assignments

Pin No.	Signal name	Explanation	Input/ output	Remarks
2	TXD	The transmitted data to external equipment.	Output	RS-232C
3	RXD	The received data from external equipment.	Input	
4	RTS	Request To Send	Output	
5	CTS	Clear To Send	Input	
6	DSR	Data Set Ready	Input	
20	DTR	Data Terminal Ready	Output	
7	SG	Control power supply 0V	-	
1	FG	Ground (Connecting the shield of the cable)	-	

Pin No.	Signal name	Explanation	Input/ output	Remarks
13	TXDH	Transmit data + side.	Output	RS-422
12	RXDH	Received-data + side.	Input	
11	DTRH	Data Terminal Ready +side	Output	
10	DSRH	Data Set Ready +side	Input	
25	TXDL	Transmit data – side	Output	
24	RXDL	Received-data – side.	Input	
23	DTRL	Data Terminal Ready – side.	Output	
22	DSRL	Data Set Ready – side.	Input	
9	SG	Control power supply 0V	–	

Table 10-4 : Connector: CNENC pin assignments

Pin No.	Signal name	Explanation	Input/ output	Remarks
2A	LAH1	Differential encoder A-phase signal + side	Input	CH1
3A	LBH1	Differential encoder B-phase signal + side	Input	
4A	LZH1	Differential encoder Z-phase signal + side	Input	
6A	LAH2	Differential encoder A-phase signal + side	Input	CH2
7A	LBH2	Differential encoder B-phase signal + side	Input	
8A	LZH2	Differential encoder Z-phase signal + side	Input	
2B	LAL1	Differential encoder A-phase signal – side	Input	CH1
3B	LBL1	Differential encoder B-phase signal –side	Input	
4B	LZL1	Differential encoder Z-phase signal –side	Input	
6B	LAL2	Differential encoder A-phase signal –side	Input	CH2
7B	LBL2	Differential encoder B-phase signal –side	Input	
8B	LZL2	Differential encoder Z-phase signal –side	Input	

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